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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/627,418	07/27/2000	Tatsuya Usami	00N010-US	1182

7590 09/25/2002

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EXAMINER

QUACH, TUAN N

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 09/25/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Advisory Action

Application No.

09/627,418

Applicant(s)

USAMI, TATSUYA

Examiner

Tuan Quach

Art Unit

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--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 29 August 2002 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE. Therefore, further action by the applicant is required to avoid abandonment of this application. A proper reply to a final rejection under 37 CFR 1.113 may only be either: (1) a timely filed amendment which places the application in condition for allowance; (2) a timely filed Notice of Appeal (with appeal fee); or (3) a timely filed Request for Continued Examination (RCE) in compliance with 37 CFR 1.114.

PERIOD FOR REPLY [check either a) or b)]

- a) ☒ The period for reply expires 3 months from the mailing date of the final rejection.
- b) ☐ The period for reply expires on: (1) the mailing date of this Advisory Action, or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.
- ONLY CHECK THIS BOX WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

1. ☐ A Notice of Appeal was filed on _____. Appellant's Brief must be filed within the period set forth in 37 CFR 1.192(a), or any extension thereof (37 CFR 1.191(d)), to avoid dismissal of the appeal.
2. ☐ The proposed amendment(s) will not be entered because:
- (a) ☐ they raise new issues that would require further consideration and/or search (see NOTE below);
 - (b) ☐ they raise the issue of new matter (see Note below);
 - (c) ☐ they are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
 - (d) ☐ they present additional claims without canceling a corresponding number of finally rejected claims.

NOTE: _____

3. ☐ Applicant's reply has overcome the following rejection(s): _____.
4. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
5. ☐ The a) ☐ affidavit, b) ☐ exhibit, or c) ☐ request for reconsideration has been considered but does NOT place the application in condition for allowance because: _____.
6. ☐ The affidavit or exhibit will NOT be considered because it is not directed SOLELY to issues which were newly raised by the Examiner in the final rejection.
7. ☒ For purposes of Appeal, the proposed amendment(s) a) ☐ will not be entered or b) ☒ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended.

The status of the claim(s) is (or will be) as follows:

Claim(s) allowed: 14.

Claim(s) objected to: _____.

Claim(s) rejected: 1-5.

Claim(s) withdrawn from consideration: _____.

8. ☐ The proposed drawing correction filed on _____ is a) ☐ approved or b) ☐ disapproved by the Examiner.
9. ☒ Note the attached Information Disclosure Statement(s) (PTO-1449) Paper No(s). 10.
10. ☒ Other: see attachment

DETAILED ACTION

The amendment after final filed August 29, 2002 has been permitted entry; the Finality of the Office action mailed June 3, 2002 (Paper No. 9) remains and is repeated below, including any further discussions regarding the newly amended features.

The requirement for a supplemental oath or declaration in Paper No. 9 page 2, first full paragraph, is maintained and repeated as delineated therein.

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lopatin et al. (Lopatin) and Zhao et al. (Zhao), taken together.

Lopatin teaches copper 24 and low dielectric constant layer, e.g., layer 30 including HSQ material thus possessing the property that Cu is unlikely to entire it since the same material is employed. The provision of via in low dielectric constant 50 followed by barrier layer 54 and copper 58 is also taught. See column 6 line 4 to column 7 line 21. Although Lopatin does not explicitly recite the Cu concentration to be equal or higher than 10^{19} atoms/cm³, such would have been encompassed in Lopatin since the concentration therein is neither required nor limited to be below the said value, and since the optimization of such concentration to obtain a desired conductivity would have been obvious to one skilled in the art. Lopatin also shows the barrier but does not recite the adhesion language, the use of tungsten and the etching rate and the polishing rate of the adhesion layer to be essentially equivalent to those of the wiring lines.

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Zhao teaches the conventional use of liner in conjunction with copper wherein the barrier also provides adhesion, including the use of tungsten for such material. See column 4 line 52 to column 5 lines 25-63. The provision of openings 24 and 25 in various low dielectric constant material, e.g., layer 14, followed by copper conductor, e.g., 29, including barrier/adhesion is also shown. See column 6 line 10 to column 8 line 45.

It would have been obvious to one skilled in the art at the time the invention was made in practicing the above invention to have included tungsten barrier/adhesion layer in question to improve adhesion/barrier characteristics in the copper interconnect. The selection of the same etching rate would have been obvious and would have been within the purview of one skilled in the art to facilitate the removal of the wiring line and the adhesion/barrier layer. Regarding the recitation concerning the polishing rate which is essentially equivalent to the polishing rate of the wiring lines, this corresponds to a notoriously conventional method for forming plugs by polishing the barrier/adhesion and the interconnect/wiring wherein such selection of essentially equivalent rate would facilitate the polishing and correspond to a conventional process as the polishing of excess barrier/adhesion and wiring material outside the via/trench to result in the plugs is well known, e.g., Zhao, column 8 lines 50-57, and further results in similar structures to that of the prior art, namely, plugs which are planarized with the adjacent insulating layer.

Applicant's arguments filed August 29, 2002 have been fully considered but they are not persuasive.

Regarding the invention in claim 14, applicant points out to the disclosure at page 7 line 15 et seq. This appears to belong to a different embodiment and not the statement of the invention. The language of original claim 1 pointed out by applicant merely refers to an insulating layer which has a property that Cu is unlikely to enter and does not appear to refer to the structure of claim 14 which requires in part a multi-layer insulating structure including a middle layer of PAE and an upper insulating layer and a lower insulating between which the middle layer is sandwiched, said upper and lower layers each comprised of HSQ.

Applicant argues that Lopatin does not teach or suggest that HSQ provides protection against the diffusion of copper and that the instant specification shows in Figs 2A-4 and 5. This fails to take into consideration the evidence of record that Lopatin clearly teaches the same insulating material said in the original disclosure as possessing the property that Cu is unlikely to enter the material, e.g., HSQ, and that Lopatin clearly teaches the use of the HSQ insulating material when Cu wiring is employed. Furthermore, the advantage alleged by applicant in Figs. 4 and 5 thus would be realized by Lopatin. The information provided and the allegation regarding the organic polymer or inorganic polymer delineated in Figs. 2A-4 further fail to characterize the particular materials, namely what are the particular materials being employed in these figures. The evidence of record however clearly supports that the use of HSQ as insulating material in conjunction with copper as wiring/interconnect is clearly taught Lopatin. Applicant has failed to show that the copper is not unlikely to enter the insulating materials employed in Lopatin, including the same HSQ material delineated.


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Applicant further argues that there is no recognition of the problem and of the solution of employing an insulating layer. This has been considered together with remaining evidence and it remains the evidence of obviousness would outweigh the evidence of non-obviousness and clearly evidence the use of copper plug without any restricted concentration within the via or trench of insulating layer such as HSQ to result in a well known plug, including the inclusion of conventional barrier/adhesion frequently employed in copper plugs as evidenced by Zhao. Applicant argues that Zhao teaches away but fails to substantiate its argument and appears to misinterpret or ignore the explicit teachings of Zhao at column 5 lines 24-26 which recites that the liner 12 under copper 10 includes barrier materials such as TiN, TaN, W, etc., and that these materials also operate to promote adhesion.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Quach whose telephone number is 703-308-1096. The examiner can normally be reached on M - F from 9 to 5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (703) 306-2794. The fax phone number for the organization where this application or proceeding is assigned is 703-308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



Tuan Quach
Primary Examiner